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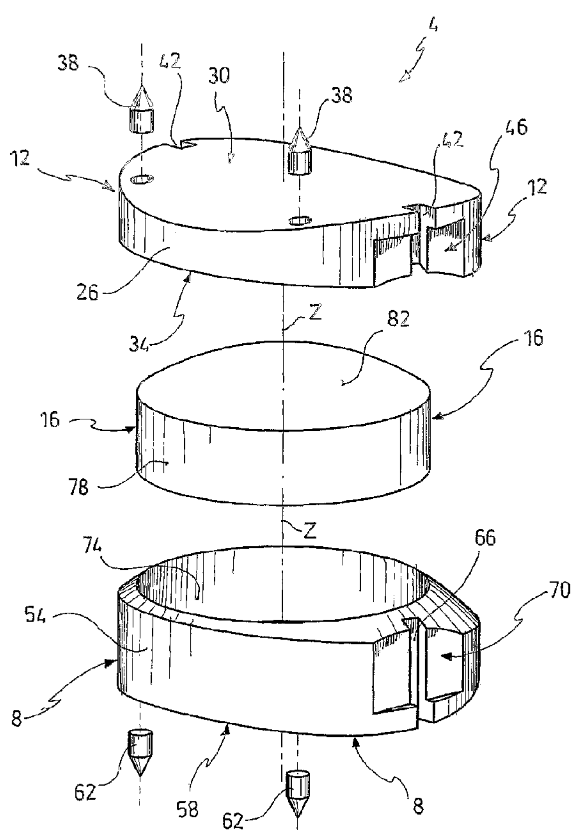
(54) Title: DISC PROSTHESIS



(57) Abstract: A disc prosthesis (4) suitable to be interposed in a seat (22) being defined between an upper vertebral body (20) and a lower vertebral body (18) which are contiguous to each other, said prosthesis (4) comprising an upper plate (12) fittedly associable to the upper vertebral body (20) and a lower plate (8) fittedly associable to the lower vertebral body (18). The lower (8) and upper (12) plates are coupled to each other according to a coupling of substantially spherical surfaces having different bending radiuses (R', R''), such as to provide a rotary-translatory coupling.

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DESCRIPTION

"DISC PROSTHESIS"

[0001] The present invention relates to a disc prosthesis, particularly a cervical disc prosthesis, suitable to restore proper kinematics between two adjacent cervical vertebrae following a degeneration or trauma of the disc interposed between the vertebrae.

[0002] Several cervical disc prostheses are known to comprise at least two bodies, each being associated to one of two contiguous vertebrae and suitable to move relative to each other to allow a relative movement between the vertebrae.

[0003] However, these prostheses may not ensure proper kinematics of the cervical spine because they may allow the welding of the two contiguous vertebrae between which they are inserted. Thus, both vertebrae tend to fasten to each other as one single body, thus limiting, particularly, the movement of flexo-extension of the relative spine length.

[0004] The problem of the present invention is to provide a disc prosthesis which solves the drawbacks mentioned with reference to the prior art.

[0005] These drawbacks and limitations are solved by means of a disc prosthesis in accordance with claim 1.

[0006] Other embodiments of the disc prosthesis according

to the invention are described in the claims below.

[0007] Further characteristics and the advantages of the present invention will be better understood from the description below of preferred and non-limiting examples thereof, in which:

[0008] figure 1 is an overall perspective view of a disc prosthesis according to the present invention;

[0009] figure 2 is a cut-away perspective view of the disc prosthesis from figure 1;

[0010] figure 3 is a side view of the disc prosthesis from figure 1, taken on the side of arrow III from figure 1;

[0011] figure 4 is a side view of the disc prosthesis from figure 1, taken on the side of arrow IV from figure 3;

[0012] figure 5 is a top view of the disc prosthesis from figure 1;

[0013] figure 6 is a sectional view of the disc prosthesis from figure 1, taken along the line VI-VI from figure 5;

[0014] figure 7 is a sectional view of the disc prosthesis from figure 1, in a relative rotary configuration between the plates of the prosthesis;

[0015] figure 8 is a side view of the disc prosthesis from figure 1, being inserted between two contiguous

vertebrae;

[0016] figure 9 is a perspective view of a gripping device to grip a disc prosthesis according to the invention;

[0017] figure 10 is a perspective view of the gripping device from figure 9 in a gripping configuration of a disc prosthesis according to the invention;

[0018] figure 11 is a perspective view of a guide plate to insert a disc prosthesis according to the invention;

[0019] figures 12A-12E are perspective views of subsequent insertion steps, between two contiguous vertebrae, of a disc prosthesis according to the invention.

[0020] Those elements or element parts in common between the embodiments described below will be designated with the same numerals.

[0021] With reference to the above figures, with 4 has been generally indicated a disc prosthesis.

[0022] Said disc prosthesis 4 comprises a lower plate 8, an upper plate 12 and a core 16. Said lower and upper plates 8,12 face each other, the core 16 being inserted therebetween.

[0023] The lower and upper plates 8,12 are suitable to interact with a lower vertebral body and an upper vertebral body 18,20 respectively, and particularly with

lower and upper vertebral plates 18′ and 20′ of said vertebral bodies 18,20 facing each other.

[0024] The vertebral bodies 18,20 are provided with relative lower and upper laminae 18′′ e 20′′.

[0025] By lower and upper vertebral body 18,20 is meant any two vertebral bodies either adjoining or contiguous to each other, arranged along a spine length, preferably along the cervical length, where the upper vertebral body 20 faces the cranial direction of the spine length and the lower vertebral body 18 faces the caudal direction of the spine. Said vertebral bodies 18,20 being adjacent to each other, defining a seat 22 suitable to house a vertebral disc and, following the removal of the disc, suitable to house a disc prosthesis 4 according to the invention.

[0026] In the following, with spinal direction S will be designed the direction of longitudinal extension being defined by at least two vertebral bodies 18,20 adjacent to each other, the disc prosthesis 4 according to the invention being suitable to be inserted therebetween. Relative to a first symmetry plane M for the spine passing through said spinal direction S, such as to be comprised between each couple of laminae of the vertebrae, a longitudinal direction L can be identified which belongs to the first symmetry plane M and

substantially perpendicular to the spinal direction S.

[0027] Along the longitudinal direction L, a vertebra rear side is identified facing the 18'', 20'' and a front side facing the vertebral bodies 18,20 and opposite said rear side relative to the longitudinal direction L.

[0028] Therefore, in the following, a longitudinal or front-rear direction L, a spinal or cranial-caudal S and a transversal direction T perpendicular to the longitudinal direction L and the spinal direction S can be identified.

[0029] The disc prosthesis according to the invention is suitable to be inserted in the seat 22 defined by the lower 18 and upper 20 vertebral bodies.

[0030] The disc prosthesis 4, in an assembly configuration of the lower 8 and upper 12 plates with the core 16 is an overall cylindrical body provided with a prosthesis axis P such that, in an insertion configuration of the prosthesis 4 into the relative seat 22, such as illustrated in figure 8, said prosthesis axis P is arranged parallel to axis S.

[0031] According to an embodiment, such as illustrated in figure 5, the disc prosthesis 4 comprises a first midplane F passing through the prosthesis axis P, such that, following the insertion of the prosthesis 4 into

the relative seat 22, the first midplane F is arranged substantially parallel to the front-rear direction L, i.e. the first midplane F overlaps to the first symmetry plane M along the spine length in question. Preferably, the first midplane F is also a symmetry plane for prosthesis 4.

[0032] According to a further embodiment, the disc prosthesis 4 comprises a second midplane G, substantially perpendicular to the first midplane F and passing through the prosthesis axis P, such that, following the insertion of the prosthesis into the seat thereof, the second midplane G is arranged substantially parallel to the transversal direction T as well perpendicular to said first symmetry plane M of the vertebral bodies.

[0033] The second midplane G divides the lower and upper plates 8,12 of the disc prosthesis 4 into two halves, and particularly, a rear portion 23 and a front portion 24. The rear portion 23 extends from a rear leading edge 23′ to the second midplane G whereas the front portion 24 extends from a front leading edge 24′ to said second midplane G.

[0034] The upper plate 12 comprises an upper plate body 26 having an upper abutment surface 30, suitable to abut against the lower vertebral plate 18′ of the upper

vertebral body 20, and a sliding surface 34 substantially spherical according to a first bending radius R′, and opposite the upper abutment surface 30 relative to the prosthesis axis P.

[0035] The upper abutment surface 30 is not perfectly planar, and preferably relative to said first midplane F, such as illustrated in figures 3 and 6, has a simple-bending arched profile, according to an upper outer bending radius Q′. In other words, this upper abutment surface 30 is slightly rounded or convex on the side of the upper vertebral body 20 to be associated thereto.

[0036] According to an embodiment, to said upper abutment surface 30 there are associated, for example by fitted coupling, two upper stems 38, such as to axially protrude from the upper abutment surface 30, having a tapered shape such as to be driven, at least partially, into the plate of a vertebral body.

[0037] Advantageously, the upper plate 12 is made in a metal material, preferably a Co-Cr-Mo-containing alloy. This alloy is bio compatible, but it is not osteo-conductive; furthermore, it ensures a particularly low friction coefficient when associated to polymeric materials.

[0038] Advantageously, to the upper abutment surface 30 there is applied a titanium-based osteo-conductive

coating layer, such as by the plasma pore technique. This coating layer ensures the bone integration of the upper abutment surface and thereby a safe fixing of the same to the relative vertebral body.

[0039] The upper plate 12 comprises a couple of upper notches 42, preferably passing through the entire thickness of the upper plate, as well as a couple of upper levellings 46, symmetrically arranged relative to said upper notches 42.

[0040] The upper levellings 46 and the upper notches 42 are suitable to interact with proper gripping means 50, such as illustrated in figures 9-11, in order to grip and place the disc prosthesis 4 into the relative seat 22.

[0041] The lower plate 8 comprises a lower plate body 54 having a lower abutment surface 58, suitable to abut against the upper vertebral plate 20′ of the lower vertebral body 18, preferably contiguous relative to said upper vertebral body 20.

[0042] The lower abutment surface 58 is not perfectly planar, but preferably, relative to said first midplane F, such as illustrated in figures 3 and 6, it has a simple-bending arched profile, according to a lower outer bending radius Q′′. In other words, this lower abutment surface 58 is slightly rounded or convex on the

side of the lower vertebral body 18 to be associated thereto. Advantageously, the bending of the lower abutment surface 58 is the same as the bending of the upper abutment surface 30, thereby the bending radiuses Q′ and Q′′ are equal to each other. In other words, both lower 30 and upper 58 abutment surfaces are symmetrical relative to a third midplane K, perpendicular to the first and second midplane F,G and passing through the midpoint of the prosthesis axis P portion being intercepted by the prosthesis.

[0043] According to a further embodiment, the bendings of the lower 58 and upper 30 abutment surfaces and hence the bending radiuses Q′ e Q′′ are different, therefore, the abutment surfaces are different, and so the abutment surfaces 30,58 are not symmetrical to each other, for example to be adapted to the different shapes of the vertebral bodies to which they are associated.

[0044] Advantageously, the thickness of the prosthesis 4 changes between the front portion 24 and the rear portion 23, by thickness being meant the distance between the upper abutment surface 30 and the lower abutment surface 58, said distance being measured both relative to a plane parallel to the first midplane F, and parallel to the prosthesis axis P.

[0045] Particularly, this thickness is greater at the

front leading edge 24′ and is smaller at the rear leading edge 23′. The prosthesis 4 has an overall rounded and wedge-shaped profile relative to a plane parallel to the first midplane F. Furthermore, said profile is symmetrical to the third midplane K.

[0046] Preferably, relative to a sectional plane parallel to the first midplane F, straight lines Y′ e Y′′ passing through the rear 23′ and front 24′ leading edges of each rear and upper plate 8,12 define an angle ranging between 3 and 7 degrees therebetween, still more preferably this angle is 5 degrees, said straight lines Y′ and Y′′ intersecting on the side of the rear portion 23 of prosthesis 4.

[0047] According to an embodiment, to said lower abutment surface 58, there are associated, for example according to a fitted coupling, two lower stems 62, such as to axially protrude from the lower abutment surface 58, being tapered such as to be at least partially driven in the upper vertebral plate 20 of the lower vertebral body 18.

[0048] Preferably, in an assembly configuration of the disc prosthesis 4, the upper stems 38 are aligned with the lower stems 62 relative to a direction parallel to the prosthesis axis P and the spinal direction S, as well as symmetrical to the third midplane K.

[0049] Advantageously, the lower plate is made of a metallic material, preferably a Co-Cr-Mo-containing alloy. This alloy is bio compatible but not osteo-conductive; furthermore, it ensures a particularly low friction coefficient when associated to polymer materials.

[0050] Advantageously, to the lower abutment surface 58 there is applied a titanium-based osteo-conductive coating layer, such as by the plasma pore technique. This coating layer ensure the bone integration of the lower abutment surface 58 and thereby a safe fixing thereof to the relative vertebral body.

[0051] The lower plate 8 comprises a couple of lower notches 66, preferably passing through the entire thickness of the lower plate 58, as well as a couple of lower levellings 70, symmetrically arranged relative to said lower notches 66.

[0052] The lower levellings 70 and the lower notches 66 are suitable to interact with proper gripping means 50, in order to grip and place the disc prosthesis.

[0053] To the purpose, advantageously in an assembly configuration, the upper and lower levellings and notches are both aligned to one another relative to a direction parallel to the prosthesis axis P and the spinal direction S, and symmetrical to the third

midplane K.

[0054] The lower plate body 54 comprises a cavity 74 suitable to at least partially house said core 16. Said cavity 74, according to an embodiment, has a cylindrical shape having a cavity axis X, said cavity axis X being preferably a symmetry axis for the cavity 74.

[0055] Advantageously, relative to the first midplane F, the cavity axis X is parallel to the prosthesis axis P of the disc prosthesis 4, and is distant therefrom by a distance or eccentricity 'e', in the front direction, i.e. to the front leading edge 24'.

[0056] The core 16 is integrally associated to one of said upper 12 or lower 8 plates, preferably to said lower plate 8.

[0057] Preferably the core 16 is associated to said cavity 74 according to a forced-type coupling.

[0058] The core 16 comprises an inserting portion 78 countershaped relative to said cavity 74 such as to be fittedly coupled thereto, having for example a cylindrical shape and a joint portion 82 shaped as a segment of a sphere with a second bending radius R'' and symmetry axis Z. The symmetry axis Z, in an assembly configuration of the core 16 into cavity 74, is overlapped to axis X. In other words, following the assembly of the core 16, the axis Z is distant from axis

P by the distance 'e', in the front direction, i.e. to the front leading edge 24'.

[0059] The difference between the bending radiuses R' and R'' allows to create a joint providing a rotary-translatory motion between the relative lower and upper plates 8,12 and thereby between the contiguous vertebral bodies 18,20.

[0060] Particularly, according to an advantageous embodiment, the following bending radius values can be used: R'= 12 mm - R''= 11 mm - Q'= Q''= 25 mm; R'= 13 mm - R''= 12 mm - Q'= Q''= 32.5 mm; R'= 14.5 mm - R''= 13.5 mm - Q' = Q'' = 41 mm; where different values relate to differently sized prosthesis to be adapted to the sizes of different cervical spine lenghts or however to the different patients' anatomies.

[0061] The joint portion 82, in an assembly configuration of the core 16 into the cavity 74, protrudes from said cavity 74 towards the upper plate 12 of a height j, said height j being measured relative to the first midplane F.

[0062] Particularly, said height j is maximum at the cavity axis X, due to the eccentricity between the cavity axis X and the prosthesis axis P.

[0063] Advantageously, following the insertion of the core 16 into the cavity 74, the profile of the joint

portion 82 is continuous to the profile of the lower plate body 54, relative to a sectional plane parallel to said first midplane F. In other words, the joint portion 82 provides with the lower plate body 54 an individual and continuous circumpherential surface having a bending radius R'', without interruption from the joint portion 82 to the lower plate body 54.

[0064] Similarly, the upper plate body 26 has its sliding surface 34 involving the full extension of the upper plate 12; in other words, the sliding surface extends all along the upper plate 12 which, on the side opposite the upper abutment surface 30, has a spherical segment configuration with bending radius R'.

[0065] Advantageously, the core 16 is made of a high-density polymer material, preferably UHMWPE (Ultra High Molecular Weight PolyEthylene) or Polyurethane (PU) such as to ensure a particularly low friction coefficient when associated to the metallic material of the plates, as well as good shock absorbing capacity.

[0066] The gripping means 50, such as illustrated in figures 9 and 10, comprise a couple of tabs 86, being preferably elastic, suitable to be inserted into the lower 66 and upper 42 notches of the disc prosthesis 4, and a retaining plate 90. The elastic tabs 86 can bend such as to be coupled to the notches and the levellings

46,70 of the prosthesis 4, thereby allowing a safe gripping thereof.

[0067] The gripping means are further suitable to cooperate with a connecting plate 94, such as illustrated in figure 11, suitable to be connected to two contiguous vertebrae to keep them retracted from each other. Particularly, the connecting plate 94 comprises a central hole 98 and a groove 100, both passing through the plate. The central hole 98 is suitable to be crossed by the disc prosthesis 4 and the groove is suitable to allow the passage of the retaining plate 90.

[0068] The prosthesis insertion surgical technique according to the invention will be now described.

[0069] In a first step, a discectomy (i.e. the removal of the disc from the relative seat being defined between two contiguous vertebral bodies) is performed.

[0070] The retraction of two adjacent vertebrae is then carried out by a suitable tooling, such as the connecting plate 94, shown in Figure 11.

[0071] This connecting plate 94 is connected to the two contiguous vertebrae, previously retracted, through screws or similar connecting tools, such as to keep the vertebrae retracted one from the other.

[0072] The surgeon can then mill the vertebral plates

facing each other and properly insert the device through the central hole 98 and groove 100.

[0073] In a subsequent phase, the disc prosthesis is inserted by moving forward the prosthesis through the central hole 98 of the connecting plate 94. Proper placement of the prosthesis into the seat is carried out with the aid of the connecting plate 94 contour, such as to place the prosthesis with the first midplane F substantially parallel to the first symmetry plane M of the spine lenght. Furthermore, as can be seen in Figure 9, the retaining plate 90 ensures the proper front-rear placement of the prosthesis; in other words, any compression by the prosthesis against the medullary cavity is avoided.

[0074] The connecting plate 94 is then removed. Following the removal of the connecting plate 94, the vertebrae tend to tighten to one another and the lower and upper stems are driven at least partially inside the respective vertebral plates. A first locking of the prosthesis within the intravertebral cavity is thus ensured.

[0075] Finally, the gripping device 50 of prosthesis 4 is removed.

[0076] The operation of the disc prosthesis according to the invention will be now described.

[0077] The coupling of the sliding surface 34 of the upper plate 12 and the joint portion 82 of core 16 provides both a substantially spherical joint, and a translation of both plates 8,12 due to the difference between the bending radiuses R′ and R′′. Accordingly, the prosthesis according to the present invention allows a motion of the rotary-translatory type of the vertebrae between which it is inserted.

[0078] The disc prosthesi according to the invention is of the self-centering type, i.e. it is inserted between the vertebral plates 18,20 of contiguous vertebrae and positions autonomously thus ensuring a proper operation, without any of the lower 8 and upper 12 plates being rigidly connected to the vertebral bodies 18,20. In a second step, the coating layer of the lower 58 and upper 30 abutment surfaces allows the bone integration of plates 8,12 into the corresponding seats.

[0079] Due to the above disc prosthesis, the movements of the contiguous vertebrae between which it is inserted are not restrained to the prosthesis itself, being the latter adapted to the physiology of the spine length involved. Particularly, the restraints to the movements of the prosthesis, and accordingly of the relating vertebrae, are dictated by the anatomy, i.e. by muscles, ligaments, spinal processes as well as the surfaces of

the vertebrae themselves. Therefore, the prosthesis does not comprise such abutment surfaces or appendixes as to provide a stop to the relative rotation between the upper plate and the lower plate. In other words, the prosthesis properly behaves like an intravertebral disc, functioning as to allow the relative roto-translation between the vertebrae, mainly leaving to the muscles and ligaments the task of restraining such relative movement. This behaviour of the prosthesis is ensured by the fact that the sliding surface 34 involves the whole extension of the upper plate 12 and the core 16 and lower plate body 54 provide a spherical surface without any interruption.

[0080] As a matter of fact, it should be noted that the sliding or roto-translation between the lower 8 and upper 12 plates is not limited by appendixes or retaining tabs placed for example at the rear 23′ or front 24′ leading edges.

[0081] As may be appreciated from what has been stated above, the above disc prosthesis allows to overcome the drawbacks of the prior art disc prostheses.

[0082] Particularly, the above disc prosthesis allows to respect the biomechanics of the cervical length such as to allow the movement of flexo-extension and torsion of the spine length without fastening the vertebrae to one

another and without creating any fastening of the hyperstatic type, particularly due to the different bending radiuses R′ and R′′.

[0083] The presence of a core having a relatively high volume in a polymer material ensures a viscoelastic behaviour of the prosthesis and a consequent shock absorption.

[0084] Furthermore, the core polymer material, when associated to the metallic material of the upper plate, ensures a low friction coefficient and avoids the phenomenon of bone regrowth around the sliding surfaces, which would cause the locking of the relative vertebrae.

[0085] Furthermore, the above disc prosthesis is not axial-asymmetrical as a whole, since it provides a forward dislocation or offset of the load such as to ensure a certain bending towards the rear direction of the spine length: the risk of kyphosis, i.e. the forward bending of the spine length, is thus avoided.

[0086] Furthermore, due to this rear bending the rear articular processes are unloaded.

[0087] Furthermore, the lordosing profile of the disc prosthesis, is wedge-shaped such as to avoid the risk of backward mobilization of the prosthesis, i.e. the rear displacement of the prosthesis along the longitudinal direction, with pressure towards the spinal cord canal

and possible serious consequences.

[0088] The presence of grooves to hook the prosthesis by suitable gripping means allows a single forceps to place the prosthesis frontally-posteriorly, cranially-caudally and torsionally.

[0089] The shape of the abutment surfaces is advantageously slightly rounded such as to avoid having to thin the vertebral seat wall too much. The surface preparation of the vertebral bodies to be operated is thus simplified, and the thinning of the vertebral plates, being the most loaded portions of the vertebral bodies, is minimized.

[0090] The disc prosthesis according to the invention is of the self-centering type, i.e. it is inserted between the vertebral plates of contiguous vertebrae without any of both lower and upper plates is rigidly connected to the vertebral bodies. The surgical technique for prosthesis insertion is thus improved. The above disc prosthesis is in fact tolerant to a surgical placement error; furthermore, it is tolerant also to uncommon anatomies.

[0091] The stems ensure the so-called primary stability, i.e. they ensure that the prosthesis is hold within the seat after it has been placed between two adjacent vertebrae, before bone integration, without any need to

use further connections such as screws or the like. On the other hand, the coating of the abutment surfaces, for example carried out by plasma techniques, ensures the bone integration of the prosthesis, i.e. a firm grip of the prosthesis to the respective vertebrae. Complicated drilling operations of the vertebrae and the risks derived therefrom are avoided.

[0092] The shape of the lower and upper plates reduces the risk that the prosthesis may dislocate, i.e. move from the relative seat.

[0093] Furthermore, the bending radiuses of the core and the upper plate are such as to avoid any risk of luxatio, i.e. the risk of relative movement of both plates. In fact, the bending radiuses are relatively small such as to ensure that when the neck ligaments are at the maximum extension relative to a cranial-caudal direction, the spherical surfaces are fastened to each other relative to a substantially perpendicular plan to this cranial-caudal direction. In other words, the maximum height j, i.e. the core joint portion is greater than the maximum extension, in the cranial-caudal direction being allowed to the vertebrae by the muscles and ligaments of the spine.

[0094] The fixing stems of the plates are a little invasive means for the vertebral body and do not require

any piercing operation to be performed by the surgeon, since they automatically dig into the vertebral plates following the removal of the intravertebral retractor.

[0095] The bending of the abutment surface is limited and does not require an invasive levelling of the plates of the vertebral bodies.

[0096] To the above disc prosthesis those skilled in the art, aiming at satisfying contingent and specific requirements, will be able to carry out a number of modifications and variations, all being contemplated within the scope of the invention such as defined by the claims below.

CLAIMS

1. Disc prosthesis (4) suitable to be interposed in a seat (22) defined between an upper vertebral body (20) and a lower vertebral body (18) contiguous to each other along a spinal direction (S), said prosthesis (4) comprising an upper plate (12) to be fittedly associated to the upper vertebral body (20) and a lower plate (8) to be fittedly associated to the lower vertebral body(18),

characterized in that

said lower (8) an upper plates (12) cooperate according to a coupling of substantially spherical surfaces having different bending radiuses (R',R''), such as to provide a coupling of the rotary-translatory type.

2. Disc prosthesis (4) according to claim 1, wherein said upper plate (12) comprises a spherical sliding surface (34) having a first bending radius (R') and said lower plate (8) comprises a spherical joint portion (82) having a second bending radius (R'') suitable to provide a coupling of the rotary-translatory type with said sliding surface (34).

3. Disc prosthesis (4) according to claim 1 or 2, wherein to said lower plate (8) there is integrally associated a core (16) having a substantially spherical

joint portion (82) according to said second bending radius (R'').

4. Disc prosthesis (4) according to claim 3, wherein said core (16) is fittedly associated to a cavity (74) of said lower plate (8), said cavity having a cavity axis (X), parallel to the prosthesis axis (P) and spaced apart therefrom by a eccentricity (e), relative to a first midplane (F) of said prosthesis (4).

5. Disc prosthesis (4) according to claim 4, wherein in an assembly configuration of the prosthesis (4) between said vertebral bodies (18,20), said eccentricity (e) frontally faces a longitudinal direction (L) perpendicular to said spinal direction (S), such as to unload the spinal processes.

6. Disc prosthesis (4) according to any claim 3 to 5, wherein said core (16) comprises said joint portion (82), such that, following the insertion of the core (16) into the cavity (74), the joint portion (82) defines with said lower plate (8) a single and continuous spherical surface having bending radius (R'').

7. Disc prosthesis (4) according to claim 6, wherein said joint portion (82) provides with said sliding surface (34) of the lower plate (12) a continuous coupling of the spherical type, such as to allow a

continuous roto-translation between the lower (18) and upper (20) vertebral bodies.

8. Disc prosthesis (4) according to any preceding claim, wherein said prosthesis (4) comprises a second midplane (G), dividing the prosthesis (4) in a rear portion (23) extending from a rear leading edge (23′) to the second midplane (G), and a front portion (24) extending from a front leading edge (24′) to said second midplane (G).

9. Disc prosthesis (4) according to claim 8, wherein a thickness of the prosthesis at the front leading edge (24′) is greater than a thickness of the prosthesis (4) at the rear leading edge (23′), such that the prosthesis (4) has an overall wedge-shaped profile.

10. Disc prosthesis (4) according to claim 8 or 9, wherein straight lines (Y′,Y′′) passing through the rear (23′) and front (24′) leading edges of each lower (8) and upper (12) plates form an angle comprised between 3 and 7 degrees, said straight lines (Y′,Y′′) by intersecting from the side of said rear leading edges (23′).

11. Disc prosthesis (4) according to claim 10, wherein said angle formed between the straight lines (Y′,Y′′) passing through the rear (23′) and front (24′) leading edges of each lower (8) and upper (12) plates is 5

degrees.

12. Disc prosthesis (4) according to any claim 2 to 11, wherein said upper plate (12) comprises an upper abutment surface (30), opposite to said sliding surface (34) and suitable to abut against a lower vertebral plate (18′) of the upper vertebral body (20), said upper abutment surface (30) having a simple-bending arched profile according to an upper outer bending radius (Q′).

13. Disc prosthesis (4) according to claim 12, wherein to said upper abutment surface (30) there are associated upper stems (38), suitable to dig into said lower vertebral plate (18′) of the upper vertebral body (20).

14. Disc prosthesis (4) according to claim 12 or 13, wherein to said upper abutment surface (30) there is applied a osteo-conductive coating layer, to ensure the bone integration of the upper abutment surface (30) with the lower vertebral plate (20′).

15. Disc prosthesis (4) according to any claim 2 to 14, wherein said lower plate (8) comprises a lower abutment surface (58), opposite to said joint portion (82), and suitable to abut against an upper vertebral plate (20′) of the lower vertebral body (18), said lower abutment surface (58) having a simple-bending arched profile according to a lower outer bending radius (Q′′).

16. Disc prosthesis (4) according to claim 15, wherein

said lower outer bending radius (Q'') is equal to said upper outer bending radius (Q').

17. Disc prosthesis (4) according to claim 15 or 16, wherein to said lower abutment surface (58) there are associated lower stems (62), being suitable to dig into said upper vertebral plate (20') of the lower vertebral body (18).

18. Disc prosthesis (4) according to any claim 14 to 16, wherein to said lower abutment surface (58) there is applied a osteo-conductive coating layer, to ensure the bone integration of the lower abutment surface (58) with the upper vertebral plate (20') of the lower vertebral body (18).

19. Disc prosthesis (4) according to any claim 2 to 18, wherein said joint portion (82) protrudes from said upper plate (12) by a maximum height (j) such as to ensure the coupling of the sliding surface (34) with the joint portion (82) at the maximum vertebral retraction in the spinal direction (S) being allowed by the muscles and ligaments to said lower (18) and upper (20) vertebral bodies.

20. Disc prosthesis (4) according to any preceding claim, wherein at least one of said upper (12) and lower (8) plates is made in a bio compatible metal alloy, such as not to favour the bone integration.

21. Disc prosthesis (4) according to claim 20, wherein said metal alloy is an alloy containing Co-Cr-Mo.

22. Disc prosthesis (4) according to any preceding claim, wherein said sliding surface (34) is made in a polymer material.

23. Disc prosthesis (4) according to claim 22, wherein said sliding surface (34) is made in UHMWPE (Ultra High Molecular Weight PolyEthylene) or Polyurethane (PU).

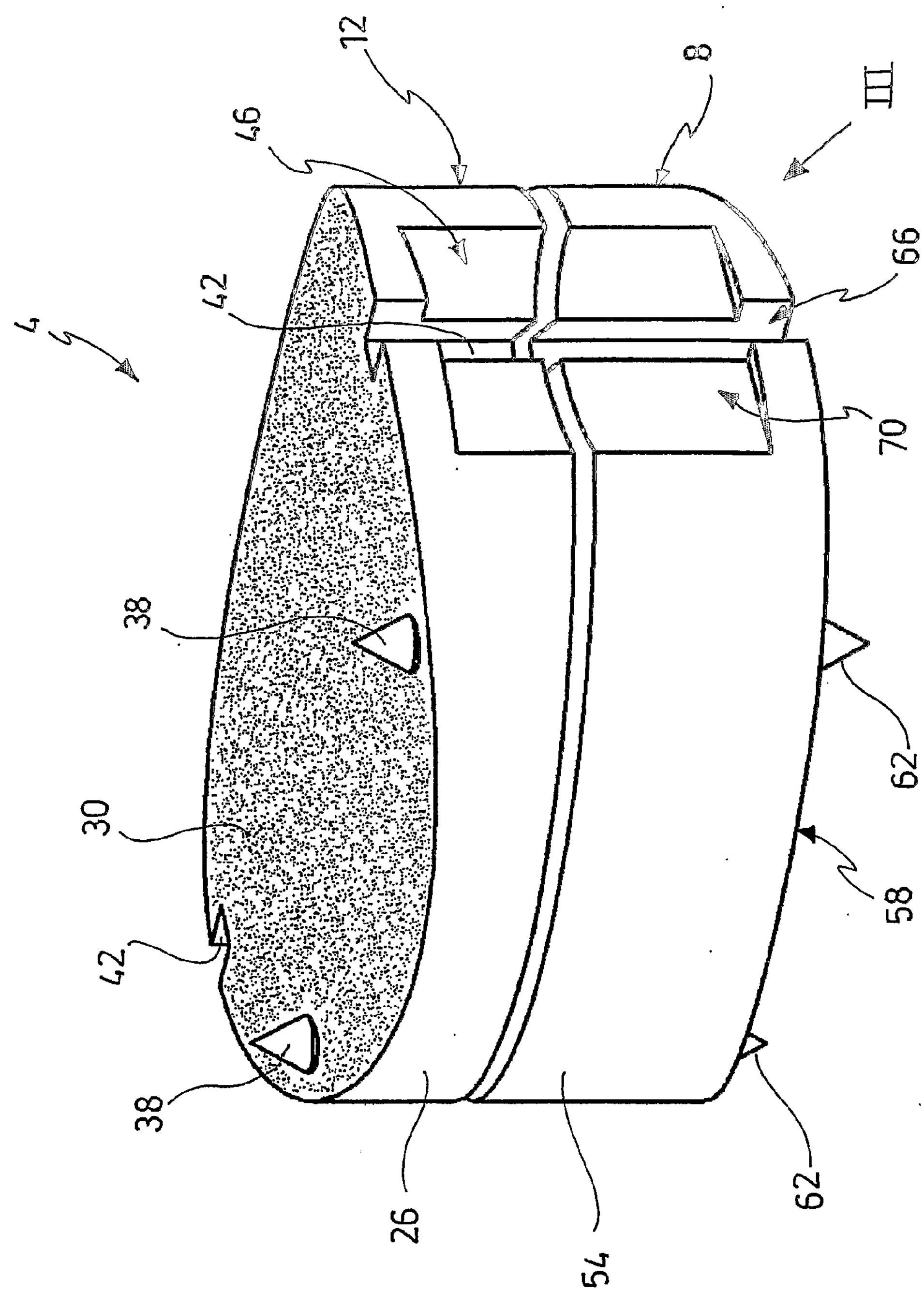

FIG.1

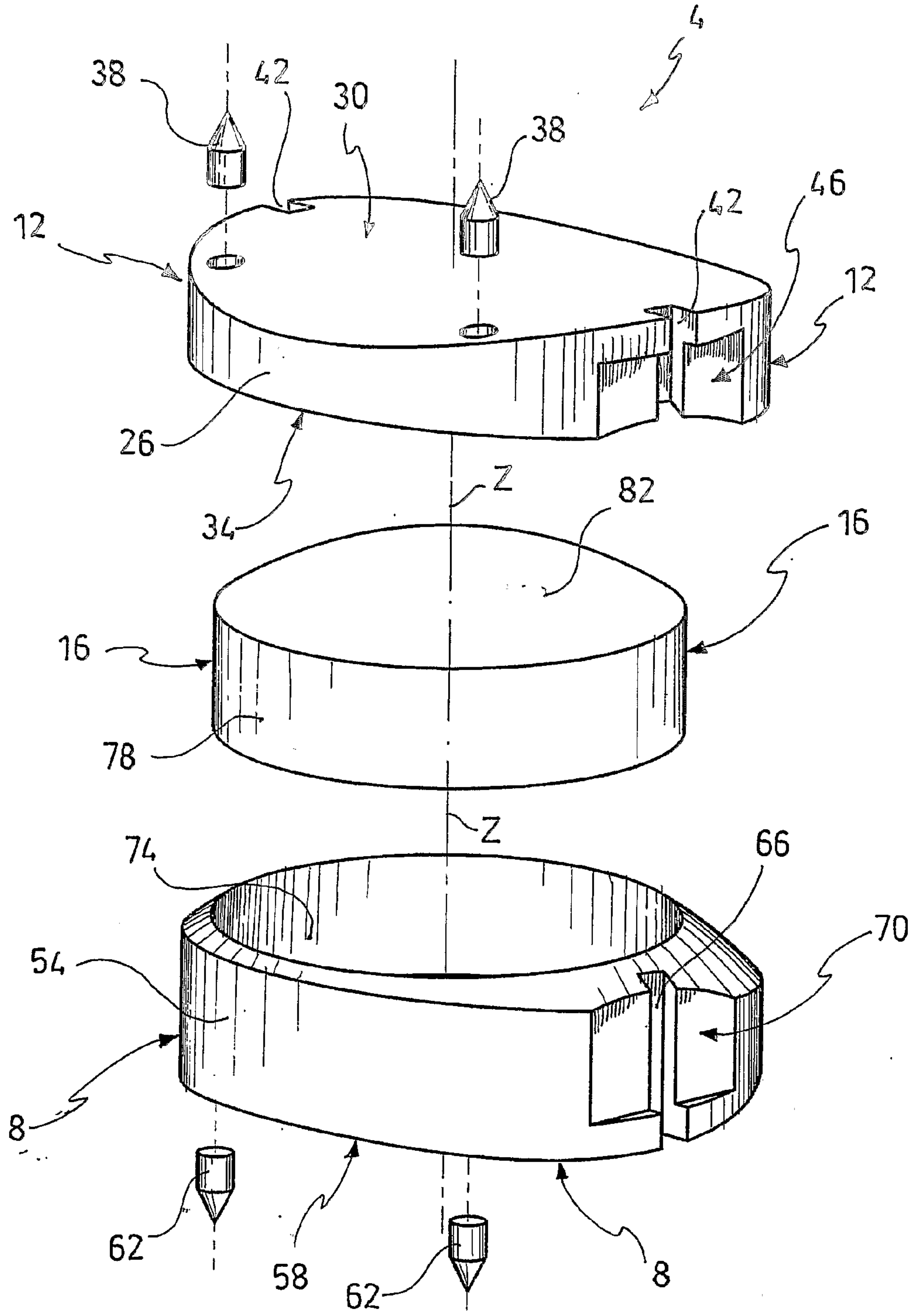

FIG. 2

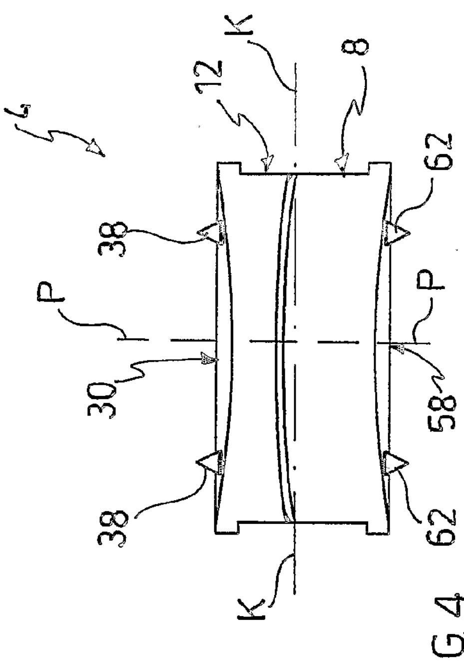

FIG.4

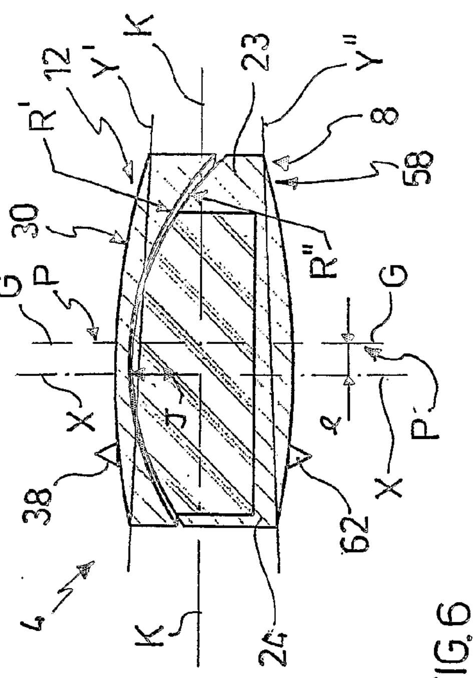

FIG.6

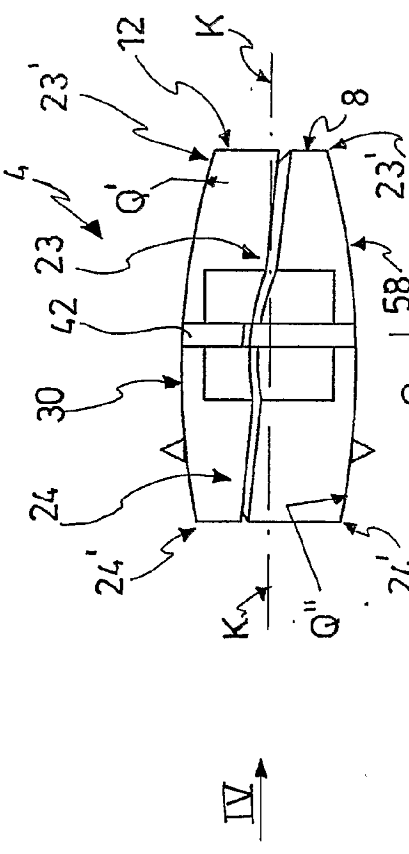

FIG.3

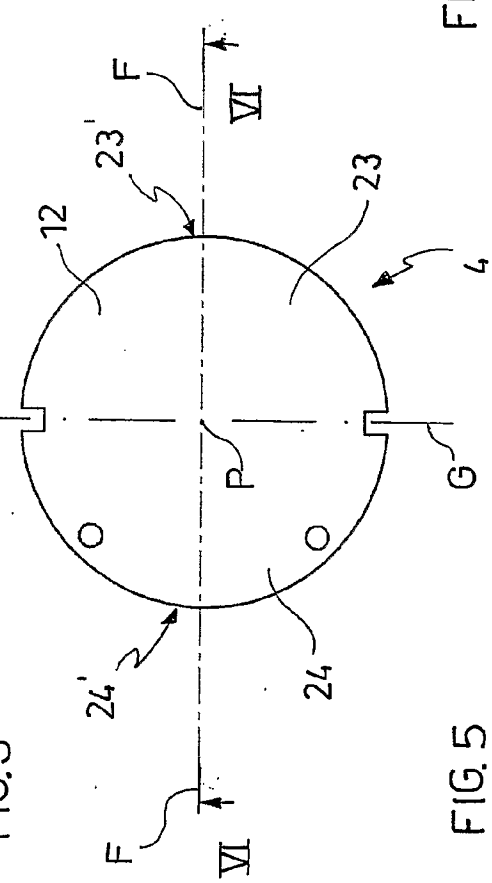

FIG.5

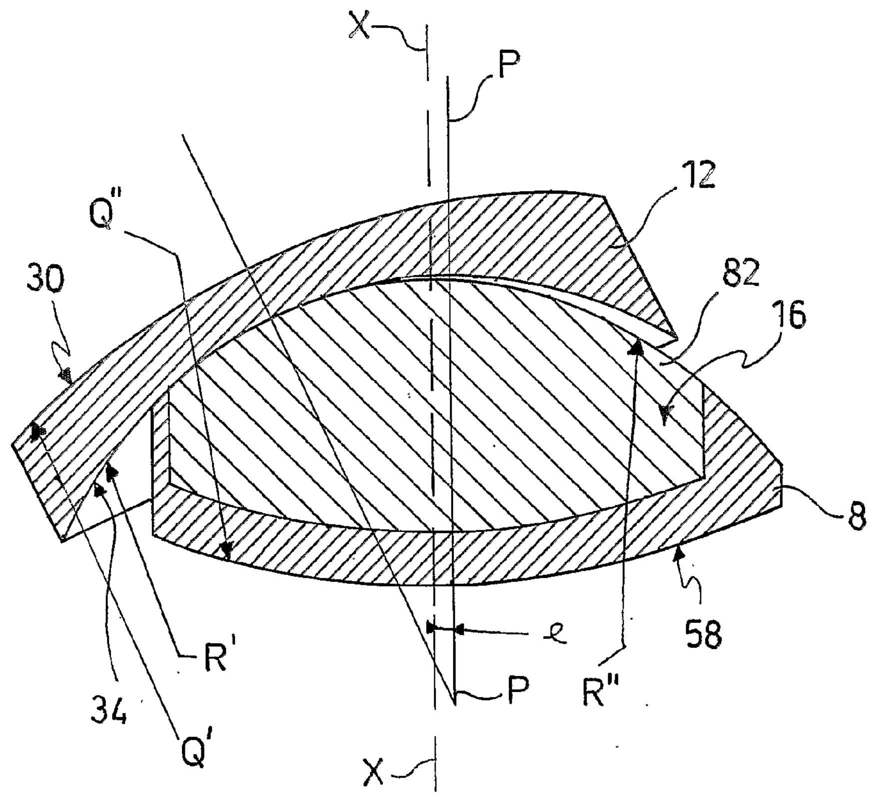

FIG. 7

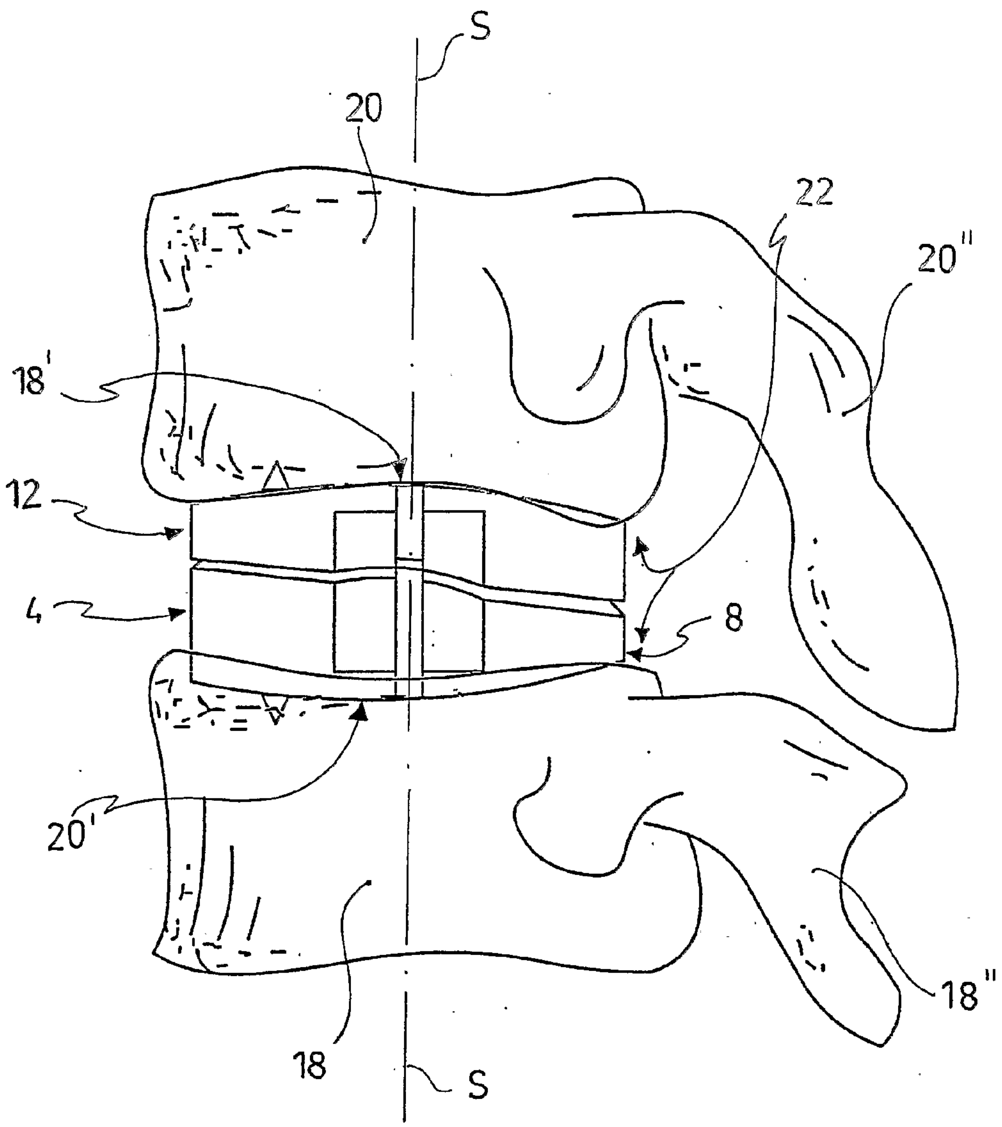

FIG.8

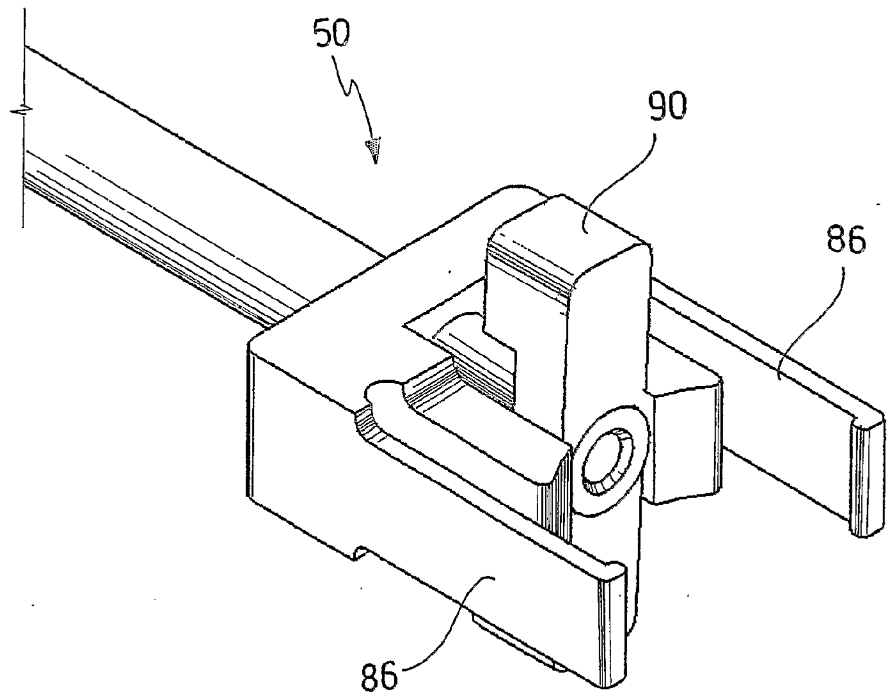

FIG.9

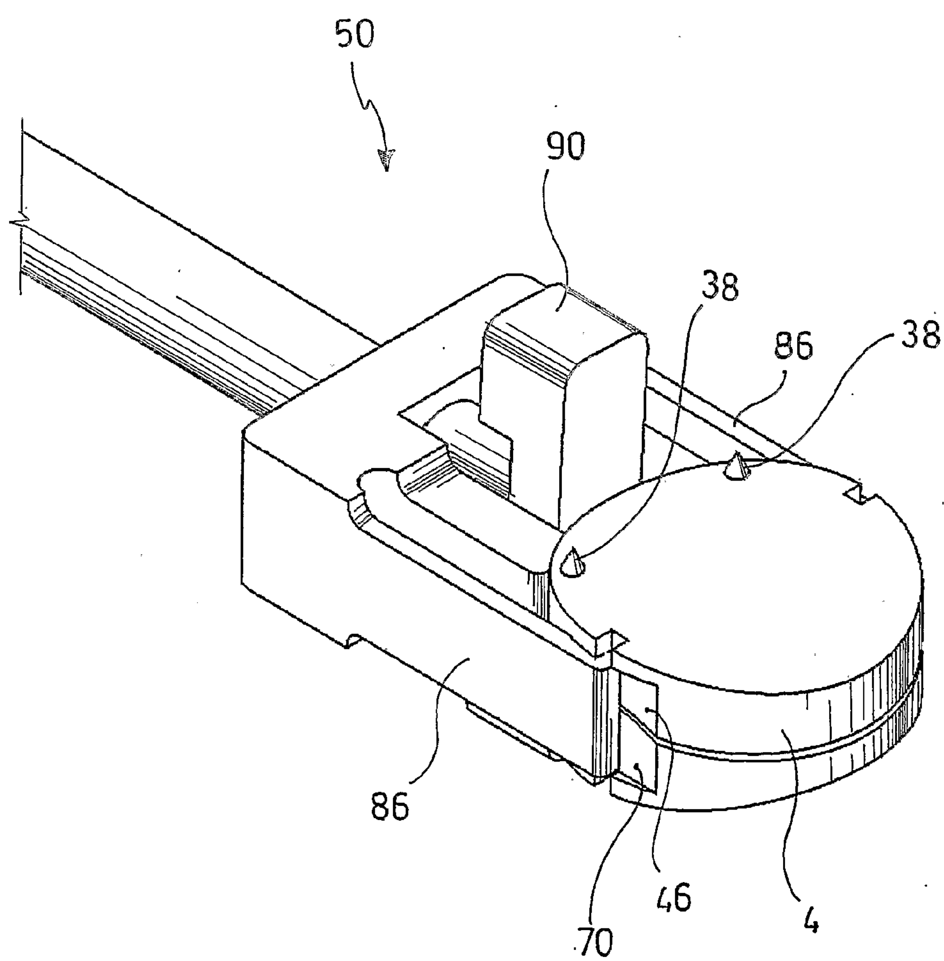

FIG. 10

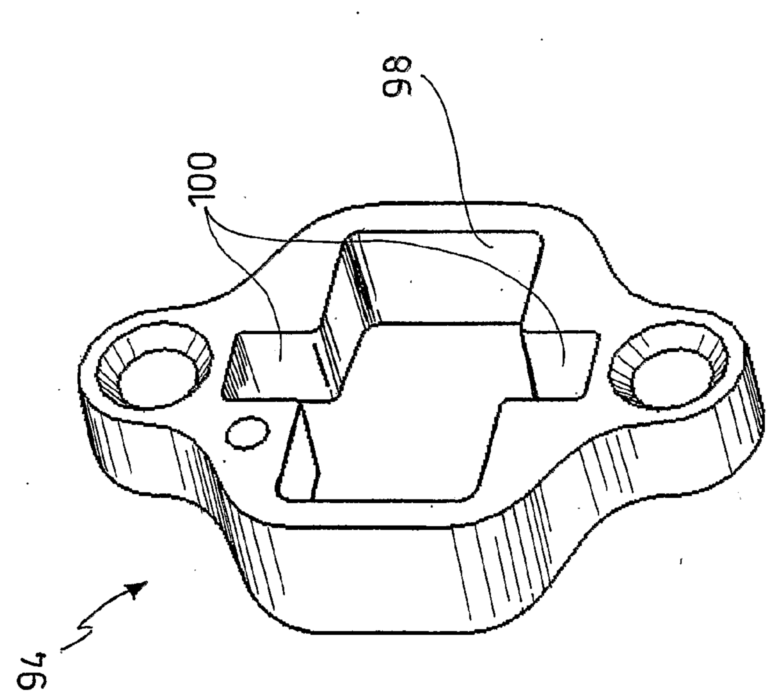

FIG. 11

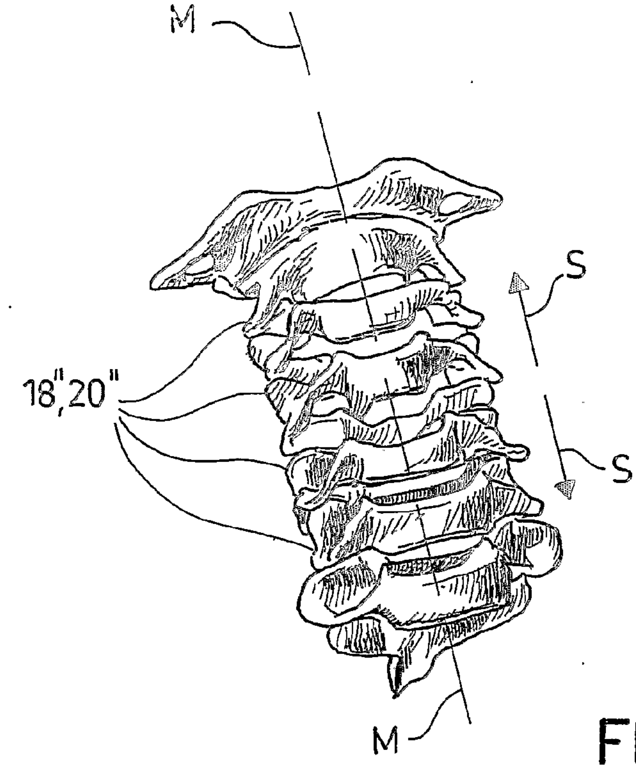

FIG.12A

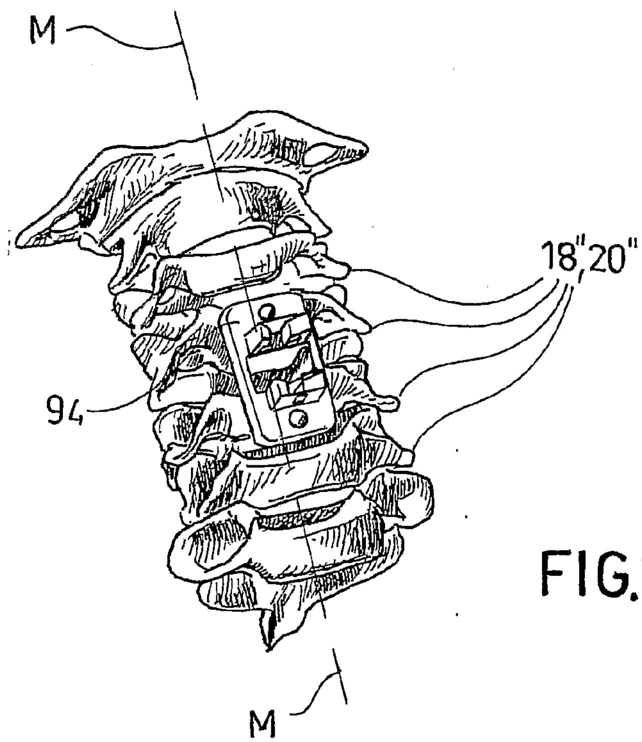

FIG.12B

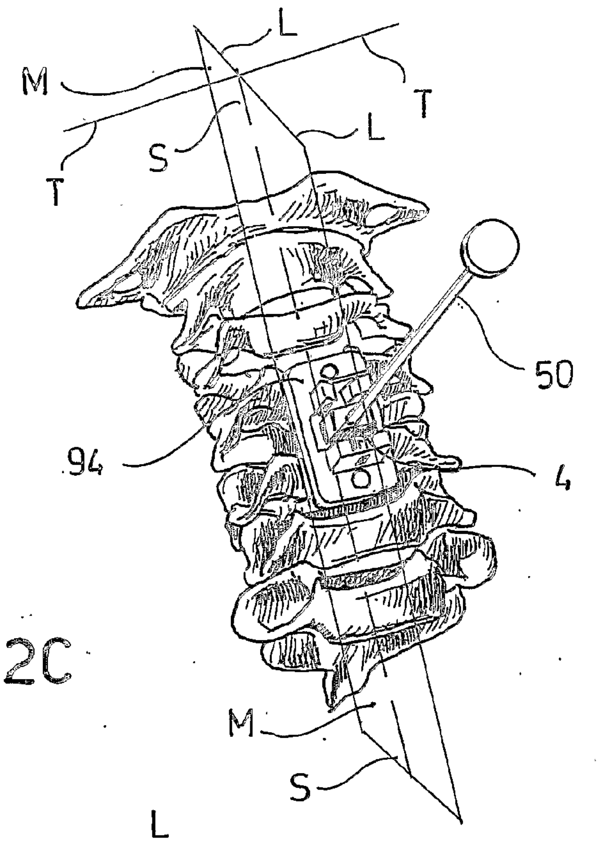

FIG.12C

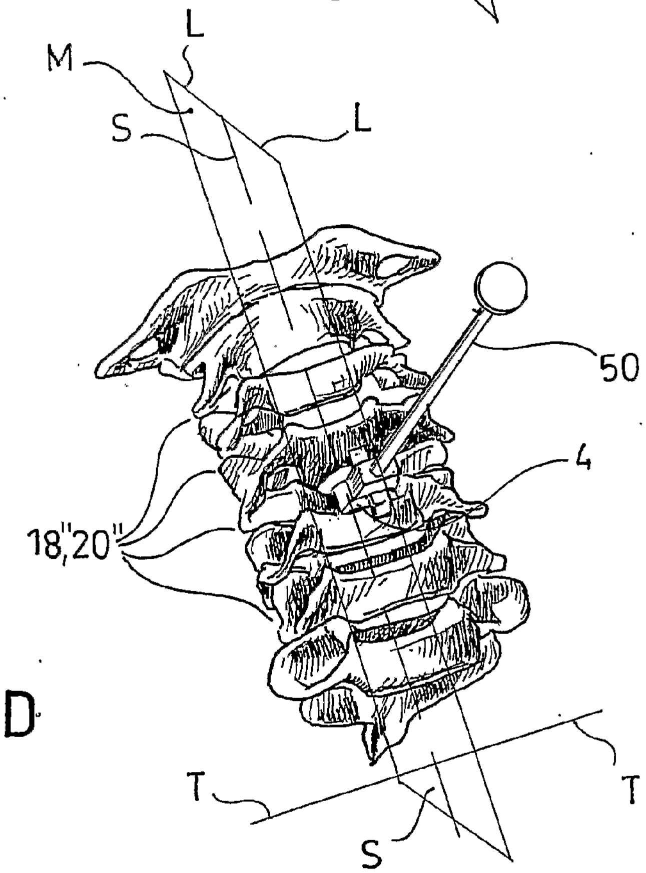

FIG.12D

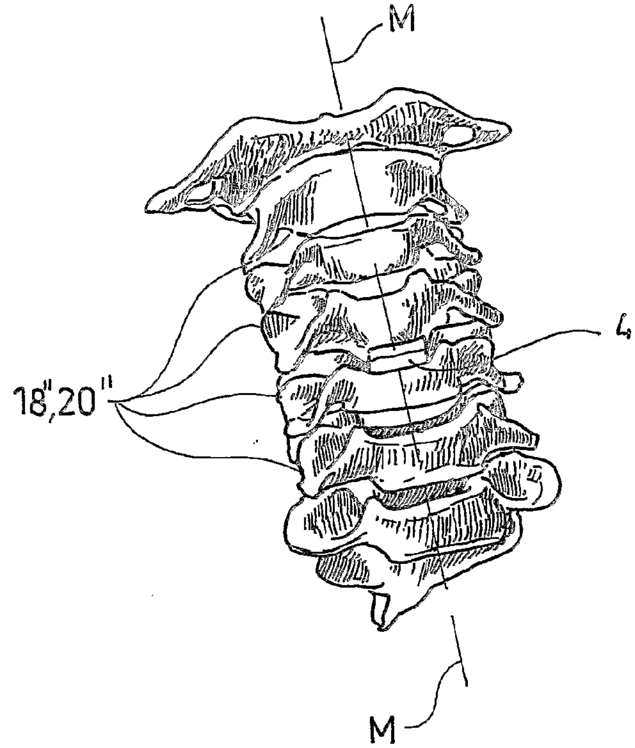

FIG. 12E

INTERNATIONAL SEARCH REPORT

PCT/IT2004/000459

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F2/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 1 374 808 A (DEPUY SPINE, INC) 2 January 2004 (2004-01-02) paragraph '0031! - paragraph '0035! paragraph '0041! - paragraph '0042! paragraph '0058! - paragraph '0061! paragraph '0087! paragraph '0136!; figures 1a,1b,1c	1-3,6-23 4,5
X	WO 02/089701 A (LDR MEDICAL; BEAURAIN, JACQUES; DELECRIN, JOEL; ONIMUS, MICHAEL; CHATA) 14 November 2002 (2002-11-14) page 8, line 27 - page 9, line 15 page 24, line 4 - line 6; figure 6a	1-3,6-8, 19-23

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2005	09/06/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Arjona Lopez, G

INTERNATIONAL SEARCH REPORT

PCT/IT2004/000459

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 00/23015 A (SDGI HOLDINGS, INC; GILL, STEVEN, S; WALKER, COLIN; VAN HOECK, JAMES;) 27 April 2000 (2000-04-27) page 3, line 6 - line 9 page 8, line 15 - line 26 page 9, line 31 - page 10, line 7; figure 1a	1,2,8, 19-23
Y	WO 2004/041131 A (SPINAL CONCEPTS, INC) 21 May 2004 (2004-05-21) page 6, paragraph 6; figures 1,4	4,5

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